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(71) Applicant: **STAMICARBON B.V.**
Mijnweg 1
NL-6167 AC Geleen(NL)

Applicant: **S.A. SCHAPPE**
B.P. 5, Charnoz
F-01800 Meximieux(FR)

(72) Inventor: **Bontemps, Guy**
76 Rue Centrale
F-01970 Tenay(FR)
Inventor: **Guevel, Jean**
La Perrinche
F-01440 Viriat(FR)
Inventor: **François, Marc**
21 chemin de la Bressonnière
F-69260 Charbonnières les Bains(FR)
Inventor: **Kriele, Johannes Elisabeth Adrianus**
Eikenlaan 7
NL-4645 JJ Putte(NL)

(54) **Composite yarn with high cut resistance and articles comprising said composite yarn.**

(57) A composite yarn with high cut resistance comprises at least one strand of wire and at least one spun yarn, which spun yarn comprises at least staple fibres of a polyolefin with a weight average molecular weight of at least 600.000 g/mole. The composite yarn is twisted.

Articles like gloves, trousers etc. comprising the composite yarn are very flexible and comfortable.

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The invention relates to a composite yarn with high cut resistance which comprises at least one strand of wire and at least one spun yarn, which spun yarn comprises at least staple fibres of a polyolefin with a weight average molecular weight of at least 600,000 g/mole.

Such a composite yarn is known from US 4.777.789.

Composite yarns with high cut resistance are used in, for example, garments intended to protect persons working in the meat industry, the metal industry or in the wood industry from being cut. Examples of such garments are gloves, aprons, trousers, cuffs, etc.

A disadvantage of the known cut-resistant composite yarn is that it is not very flexible. Because of this, garments comprising the composite yarn are not very comfortable and greatly obstruct the wearer in his activities.

The invention provides a composite yarn that presents this disadvantage to a considerably reduced extent.

This is achieved because the composite yarn according to the invention is twisted. An additional advantage of the composite yarn according to the invention is that it can be produced in a simpler manner than the known composite yarn. Another additional advantage of the composite yarn according to the invention is that its cut resistance is retained at a high level after prolonged use or after frequent washing of an article comprising the composite yarn.

Preferably, linear polyethylene is used as polyolefin for the staple fibres of the spun yarn. Linear polyethylene is here understood to be polyethylene with less than 1 side chain per 100 C atoms and preferably with less than 1 side chain per 300 C atoms, which polyethylene may moreover contain up to 5 mol.% of one or more other copolymerisable olefins such as propylene, butylene, pentene, 4-methylpentene, octene.

Other polyolefins may also be considered, for example polypropylene homo- and copolymers. In addition, the polyolefins used may contain small amounts of one or more other polymers, in particular alkene-1-polymers. Good results can be obtained if the staple fibres are produced by producing filaments by means of gel spinning and reducing said filaments. The gel spinning process is described in, for example, GB-A-2.042.414 and GB-A-2.051.667. In principle, this process consists in preparing a solution of the polyolefin, shaping the solution into filaments at a temperature above the dissolution temperature of the polyolefin, cooling the filaments to below the dissolution temperature to effect gelling, and stretching the filaments and simultaneously removing the solvent. The filaments thus obtained can be reduced to staple fibres with

the aid of the known processes. The length of the staple fibres is for example between 1 and 300 mm.

Staple fibres that are very suitable for the composite yarn according to the invention are obtained if the filaments are reduced by means of stretch breaking. The stretch breaking process is described in, for example, G.R. Wray, Modern composite yarn Production, Columbine Press, Manchester & London, 1960.

Equipment suitable for stretch breaking is per example supplied by Seydel in Germany.

The principle of the stretch breaking process is that a bundle of filaments is successively passed between a first and a second pair of rollers, the second of which rotates at a higher speed than the first, so that the filaments are stretched to breaking point. In this manner a bundle of staple fibres is formed from the bundle of filaments. The length of the staple fibres in the bundle varies. Good results can be obtained if the staple fibres thus obtained have an average length of between 40 mm and 180 mm, preferably between 60 mm and 140 mm, more preferably between 110 mm and 130 mm. The staple fibres obtained with the aid of the known processes and by means of stretch breaking can be spun into a spun yarn. A spun yarn suitable for the invention can have a thickness expressed in metric number of between M.n. 1 and M.n. 160.

Good results also can be obtained if the staple fibres are mixed with other staple fibres with the aid of the known methods and the mixture of the staple fibres and the other staple fibres is spun into a spun yarn. The other staple fibres may be natural, artificial or synthetic staple fibres. Natural staple fibres are here understood to be naturally occurring staple fibres such as cotton, wool, silk, jute, linen and the like. Artificial staple fibres are here understood to be staple fibres produced from natural polymers, whether or not modified, such as rayon, which is produced from cellulose. Synthetic staple fibres are here understood to be staple fibres produced from a synthetic polymer, such as aramide staple fibres, polyester staple fibres, polypropylene staple fibres. Preferably, polyamide staple fibres are used in the yarn according to the invention.

Of course, if the other staple fibres are not available as such, said staple fibres may be produced from filaments by reducing said filaments with the aid of the known methods or by means of stretch breaking.

The strand of wire may comprise any suitable metal, such as aluminium, copper, bronze, steel and the like. Preferably, use is made of an annealed, stainless steel wire with a thickness of between 0.060 mm and 0.160 mm, preferably between 0.080 and 0.140 mm. The composite yarn is

produced by twisting the strands with the aid of the known methods.

A composite yarn that is very suitable for the invention consists of one strand of annealed stainless steel wire and two spun yarns.

Preferably, the composite yarn is twisted between 2 and 6 times per linear cm, more preferably between 3.5 and 4.5 times per linear cm.

The invention also relates to articles comprising the composite yarn with high cut resistance according to the invention.

The articles can be made by weaving, plaiting or knitting the composite yarn, if so desired in combination with one or more other yarns.

The composite yarn may be used in protective garments such as gloves, aprons, trousers, cuffs and the like. Such garments may be worn by, for example, persons working in the meat industry, the metal industry or in the wood industry. The composite yarn may also be used in vandal-proof articles such as seats in train compartments. In addition, the composite yarn may be used in hosing or in hose coverings, for example fire-hoses.

The invention is further illustrated with reference to the example, without being limited thereto.

Example

A 1600 denier Dyneema[®] SK 60 filament yarn was reduced to a bundle of staple fibres by means of stretch breaking, with the aid of Seydel[®] equipment. Dyneema[®] SK 60 is a strong polyethylene fibre, produced by means of gel spinning, which is supplied by DSM HPF in the Netherlands. The average length of the staple fibres was 120 mm.

In the same manner a 100 KTex polyamide filament yarn supplied by Rhône Poulenc, was reduced to a bundle of staple fibres with an average length of 120 mm.

The bundles of staple fibres thus obtained were mixed using Schlumberger[®] equipment type NSC and were spun into a yarn with the aid of Comelor[®] equipment of the long staple fiber type. The polyethylene/polyamide volumetric ratio of the staple fibres in the yarn was 50/50.

With the aid of Hamel[®] equipment of the two passages type, a composite yarn with high cut resistance was twisted from two of the aforementioned yarns and one strand of Inox 18/10 wire. Inox 18/10 is an annealed stainless steel wire with a thickness of 0.080 mm, which is supplied by Sassenscheidt (RFA).

The composite yarn comprised 3.9 twists/cm. A glove was knitted from the composite yarn, using Shima[®] equipment, into a circular knit construction. The glove was very flexible and very comfortable.

The cut resistance of the glove was determined by the Institut Textile de France at Lyons according

to the NF S75 - 001 standard.

The cut resistance was determined before and after abrasion. The abrasion was effected with the aid of the usomètre Lhomargy, using the abrasive P400, which was replaced every 1000 cycles. The weight used was 500 g.

A sample measuring 10 x 6 cm was taken from the palm of the glove. The maximum cutting speed was 10 cm/s. The knife was pressed against the sample with a normal force of 5 N.

The result obtained before abrasion of the glove was 20.4 (the average of 5 tests) units according to standard NF S75 - 001 and after abrasion 17.5 (average of 5 tests) units.

To be admitted to the highest class (class 4) of cut-resistant articles, an article must yield a result of 10 units. It is clear that the glove comprising the composite yarn according to the invention amply meets this requirement.

A comparative test was carried out using a number of the commercially most successful gloves. Only one other glove yielded a higher cut resistance value before abrasion than the glove according to the invention. However, this glove was less flexible and also comprised a composite yarn that is to be produced in a more complex manner than the composite yarn according to the invention. After abrasion the cut resistance value obtained with the glove according to the invention was higher than that obtained with the aforementioned glove.

Claims

1. Composite yarn with high cut resistance, which comprises at least one strand of wire and at least one spun yarn, which spun yarn comprises at least staple fibres of a polyolefin with a weight average molecular weight of at least 600,000 g/mole, characterized in that the composite yarn is twisted.
2. Composite yarn according to claim 1, characterized in that linear polyethylene is used as polyolefin.
3. Composite yarn according to claim 1 or 2, characterized in that the staple fibres are reduced filaments which filaments are obtained by means of the gel spinning process.
4. Composite yarn according to any one of claims 1-3, characterized in that the spun yarn contains other staple fibres.
5. Composite yarn according to claim 4, characterized in that the other staple fibres are polyamide fibres.

6. Composite yarn according to any one of claims 1-5, characterized in that the staple fibres are obtained by reducing filaments by means of stretch breaking.

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7. Composite yarn according to any one of claims 1-6, characterized in that the strand of wire is a strand of annealed stainless steel wire.

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8. Composite yarn according to any one of claims 1-7, characterized in that it comprises one strand of wire and two spun yarns.

9. Articles comprising the composite yarn according to any one of claims 1-8.

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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 0435

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A,X	DE-A-1 560 228 (A. JASICEK) * Claims 1,5-8; page 9, lines 4-22 * - - -	1	D 02 G 3/12
A,X	WO-A-8 000 069 (THE GOODYEAR TIRE & RUBBER CO.) * Claim 17 * - - -	1	
A,X	FR-A-2 276 409 (TOYO BOSEKI K.K.) * Page 2, lines 12-19; page 1, lines 1-17; claims 1,3,4,5,6 * - - -	2,4-5	
A,X	GB-A-2 018 323 (BETTCHER INDUSTRIES INC.) * Column 1, lines 30-43; claims 6,7 * - - -	7-9	
A,X	DE-A-2 111 780 (BRUNSWICK CORP.) - - - - -		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D 02 G D 07 B A 41 D
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		15 May 91	TAMME H.-M.N.
<div>CATEGORY OF CITED DOCUMENTS</div> <div>E: earlier patent document, but published on, or after the filing date</div> <div>D: document cited in the application</div> <div>L: document cited for other reasons</div> <div>&: member of the same patent family, corresponding document</div> <div>X: particularly relevant if taken alone</div> <div>Y: particularly relevant if combined with another document of the same category</div> <div>A: technological background</div> <div>O: non-written disclosure</div> <div>P: intermediate document</div> <div>T: theory or principle underlying the invention</div>			